

TECHNICAL MEMORANDUM



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DATE: July 30, 2002
SUBJECT: Nylon Filter Extraction Study

Executive Summary

Questions have recently been raised about the efficiency of extracting a Nylon® filter for the analysis of ions. Specifically, is deionized water a suitable solvent for extracting the nitrate ion from the ambient air Nylon® filter? Currently most of the PM_{2.5} speciation samples are extracted with deionized water although some laboratories use an aqueous buffer as the extraction solvent. This study has examined the two most frequently used extraction methods which are routinely applied to Nylon® filters collected by the Speciation Trends Network (STN) and the Interagency Monitoring of Protected Visual Environments (IMPROVE) network.

Experiments were recently performed at the National Air and Radiation Environmental Laboratory (NAREL) to measure the efficiency of deionized water extractions. The experiments were designed to extract an ambient air filter more than once and measure the amount of analyte recovered by each extraction. Each filter was extracted twice with deionized water, and then each filter was extracted a third time with a carbonate/bicarbonate buffer. Some filters required a fourth extraction, using the buffer, before target ions were no longer observed in the extract. The efficiency of the original extraction was calculated as follows.

$$\text{efficiency} = \frac{\text{amount of ion from first extraction}}{\text{total amount of ion from all extractions}} \quad \text{Eq. 1}$$

This study utilized seventy-two carefully selected ambient air filters which were originally extracted and analyzed by the prime contractor, Research Triangle Institute (RTI). Filters and original extracts were removed from RTI's refrigerated archive and shipped to NAREL for this study. Samples were selected from fifty-six locations across the nation to include a variety of ambient air compositions. Since nitrate was the analyte of greatest concern, special attention was given to selecting only those samples with a significant level of captured nitrate (greater than twenty micrograms per filter) as revealed by RTI's original sample analysis.

The two extraction methods evaluated in this study shall be referred to as the STN method and the IMPROVE method. The STN method was applied to routine 47-mm filters loaded by a variety of sampler devices located at mostly urban sites. The IMPROVE method was used to extract 37-mm filters loaded by only one type of sampler, the IMPROVE sampler, located at mostly rural sites. All sampling events were in the fall season during October or November of 2001.

Analytical results from this study demonstrate good efficiencies for both extraction methods as shown in Table 1.

Table 1		Summary of Extraction Efficiencies			
Method	Analyte	Mean	Std. Dev.	Range	Pool of Values (n)
STN	nitrate	90%	6%	78-	37
STN	sulfate	96%	4%	85-	32
STN	ammonium	99%	<1%	99-	23
STN	sodium	-----	-----	-----	0
STN	potassium	98%	<1%	98-99%	9
IMPROVE	nitrate	94%	3%	87-98%	35
IMPROVE	sulfate	97%	2%	90-99%	35
IMPROVE	chloride	98%	1%	96-99%	35
IMPROVE	nitrite	-----	-----	-----	0
IMPROVE	ammonium	100%	<1%	98-	29

The lowest nitrate recovery was 78% observed for the STN sample collected at Queens College, NY. This sample also produced the lowest sulfate recovery (85%). Nitrate recovery was consistently lower than the sulfate recovery by a small margin. Other ions such as ammonium and chloride were present at a significant level in many samples, and excellent extraction efficiencies were observed for these ions.

History and Background

The IMPROVE network and the STN were recently expanded to include approximately three hundred air monitoring stations across the nation. These two networks are similar in design and function although the older IMPROVE network was optimized for visibility issues at rural locations, and the STN was optimized for trend analysis at urban locations. Both networks capture fine particulate matter (PM_{2.5}) from the ambient air which is routinely analyzed for the presence of several ions. IMPROVE samples are normally submitted for the analysis of four anions (chloride, nitrite, nitrate, and sulfate), and recently some IMPROVE samples are also submitted for the analysis of the ammonium ion. STN samples are normally

analyzed for two anions (nitrate and sulfate) and three cations (ammonium, potassium, and sodium). All of these ions are captured as deposits onto the surface of a Nylon® membrane filter. During the 24-hour collection event, sampled air must pass through a denuder which should remove acid vapors before the air approaches the Nylon® filter. After the sampling event is complete, the loaded filter must be shipped to the laboratory where it is extracted using an appropriate solvent to dissolve the captured ions. A small volume of the filter extract must be injected into a calibrated Ion Chromatograph (IC) to complete the analysis. The IC instrument provides results expressed as micrograms of ion per milliliter of extract injected. The instrument results may be converted to ambient air concentration using Equation 2.

$$\text{ambient air concentration} = \frac{\mu\text{g}}{\text{ml}} \times \frac{\text{volume of filter extract}}{\text{volume of air sampled}} \quad \text{Eq. 2}$$

Two separate IC instruments are required to determine the anions and the cations. One instrument is optimized for the analysis of anions, and the other IC is optimized for analysis of cations.

There are four critical steps in the overall analytical method for determining ions present in the ambient air: (1) capturing the sample, (2) preserving the sample, (3) extracting the sample, and (4) analyzing the extract. This study has examined the extraction methods which are currently used for STN and IMPROVE samples.

There are at least three approaches to testing an extraction method.

1. Extract each ambient air filter more than once and measure the amount of analyte recovered from each extraction.
2. Collect ambient air filter replicates and extract each replicate using a different method to compare the efficiency of each method.
3. Cut the ambient air filter into equal pieces and extract each piece using a different method to compare the efficiency of each method. This approach assumes a homogeneous filter deposit.

This study utilized approach #1. This study assumes that multiple extractions of the same filter will eventually recover all of the target ions so that accurate efficiencies may be calculated with Equation 1 which appears earlier in this report.

RTI has within their refrigerated archive many STN and IMPROVE ambient air samples which have already been analyzed for selected anions and cations. Each filter has been stored in the original 50-mL extraction tube along with remaining extract. Thirty-seven STN samples and thirty-five IMPROVE samples were taken from the archive which satisfy the following conditions:

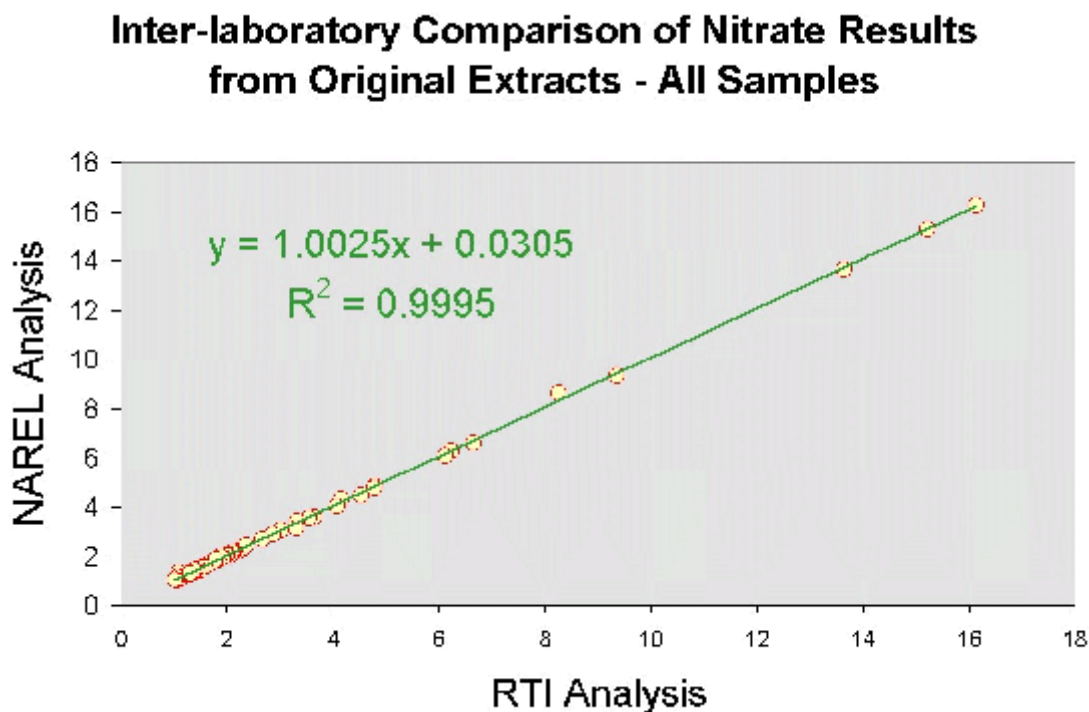
- Nitrate level was reported at 20 micrograms per filter or higher.
- No flags were assigned to the ion analysis during data validation at RTI which might compromise the integrity of this study.
- Samples were taken from several locations that included California, middle America, and the east coast.

This study has examined filters from a variety of locations but from only one season (October/November collections). By utilizing routine samples already analyzed and reported by the prime contractor, a minimum of EPA program resources has been required to support this study.

Experimental

All of the filters and original extracts were removed from RTI's refrigerated archive and shipped to NAREL in a cooler by express mail. Extracts were immediately re-analyzed at NAREL, and good inter-laboratory agreement was observed for all ions. The nitrate results from both laboratories are presented in Figure 1.

Figure 1



The instrumentation and the analytical method used at NAREL^{1,2} for this study were essentially the same as those used at the RTI.^{3,4} The novelty was extracting each filter more than once. The second extraction began by carefully removing each filter from the original extraction tube and placing it into a new clean extraction tube. Care was taken to transfer a minimum of the original extract into the second tube.

A crude experiment was performed to estimate the volume of crossover. A “dry” blank Nylon® filter was weighed, extracted, and then transferred from its extraction tube back onto the balance pan to measure the mass of transferred liquid. Less than 0.1 gram of liquid was transferred with the filter onto the balance pan which is equivalent to 0.4% of the total filter extract [0.1 mL/25 mL = 0.4%].

The second extraction of each filter was performed using the same procedure that RTI used for the original extraction. The method for STN samples and for IMPROVE samples are slightly different as described here.

For STN samples, a 25-mL aliquot of deionized water was added to each tube to cover the 47-mm filter, and the tubes were placed into an ultrasonic bath for 60 minutes. Ice was added to the bath as needed to prevent the temperature from exceeding 27 °C. After the sonication period was complete, the tubes were moved into a cold room maintained at 4 °C and placed on a horizontal shaker table set to run overnight at 60 cycle per minute. Extracts were ready for analysis of anions and cations the following day.

For IMPROVE samples, a 20-mL aliquot of deionized water was added to each tube to cover the 37-mm filter, and the tubes were placed into an ultrasonic bath for 30 minutes. Ice was added to the bath as needed to prevent the temperature from exceeding 27 °C. After the sonication period was complete, the tubes were allowed to stand at room temperature overnight. Extracts were ready for analysis of anions and cations the following day.

A third extraction of each filter was performed exactly as described for the second extraction with one exception: a buffer composed of 0.3 mM sodium bicarbonate / 2.7 mM sodium carbonate was used as the extraction solvent instead of deionized water. The carbonate buffer has a pH of approximately 10. Because of the extremely high level of sodium ion present in the buffer, the third and fourth extracts were analyzed for anions only. The extreme level of sodium in the buffer obviously prohibits a useful analysis of sodium in the sample, but the buffer also produced chromatographic interference for the ammonium ion.

A fourth extraction of each STN filter was performed exactly as described for the third extraction. A fourth extraction was not performed for the IMPROVE samples because none of the third extracts contained a significant level of the target ions.

Results for all of the analyses are presented in Table 2 through Table 8 at the end of this report. Within each table, the STN samples are listed first, and the IMPROVE samples are listed together at the end of the table. Samples are also listed in order of decreasing nitrate capture. The nitrate extraction efficiencies were calculated for all seventy-two samples. The extraction efficiency was also calculated for other ions if the concentration present in the sample was sufficiently high. Efficiencies were not calculated for those ions present in the original extract at a concentration lower than 0.5 ug/mL, as reflected by the “low capture” message which does appear in some of the data tables. The lowest calibration standard routinely analyzed at NAREL offers an ion concentration of 0.04 ug/mL, and this concentration is considered the lowest limit for accurate quantification. Lower concentration values have not been censured and are presented in Table 2 through Table 8 since they were above the instrument detection limit.

Some efficiencies have been plotted for easy viewing. The nitrate, sulfate, and ammonium efficiencies observed from the STN samples are plotted in Figure 2. The nitrate, sulfate, chloride, and ammonium efficiencies observed from IMPROVE samples are plotted in Figure 3. Within Figure 2 and Figure 3, the samples are plotted from left to right in order of decreasing nitrate capture.

Figure 2

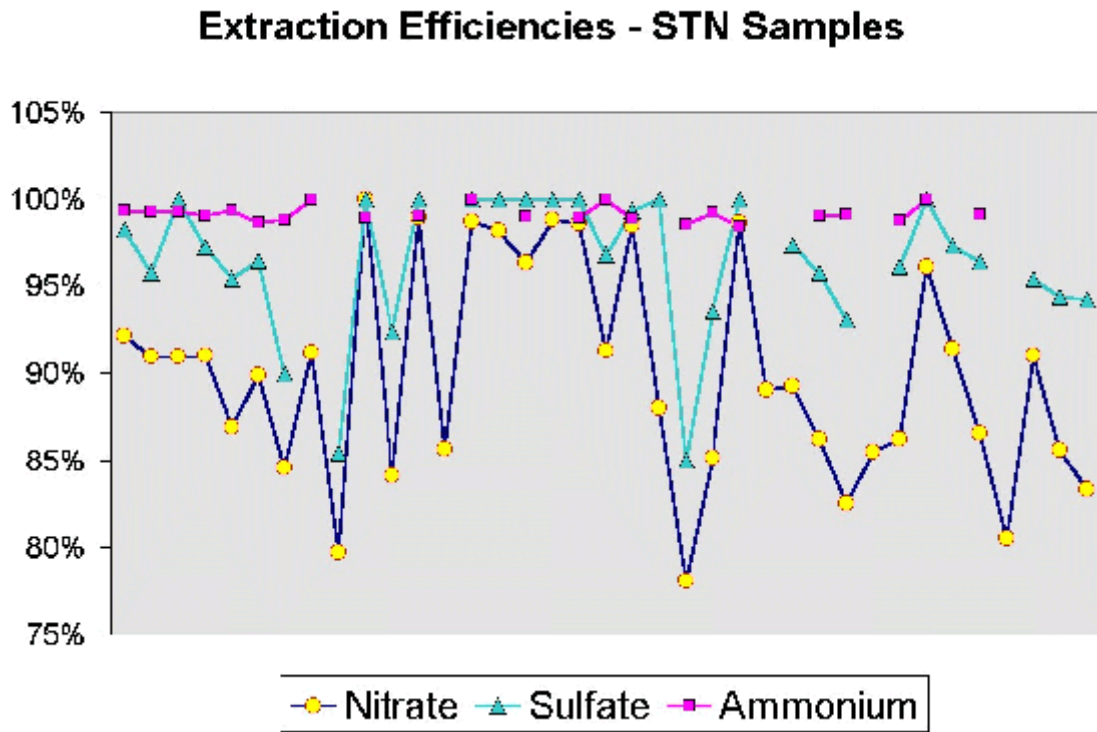
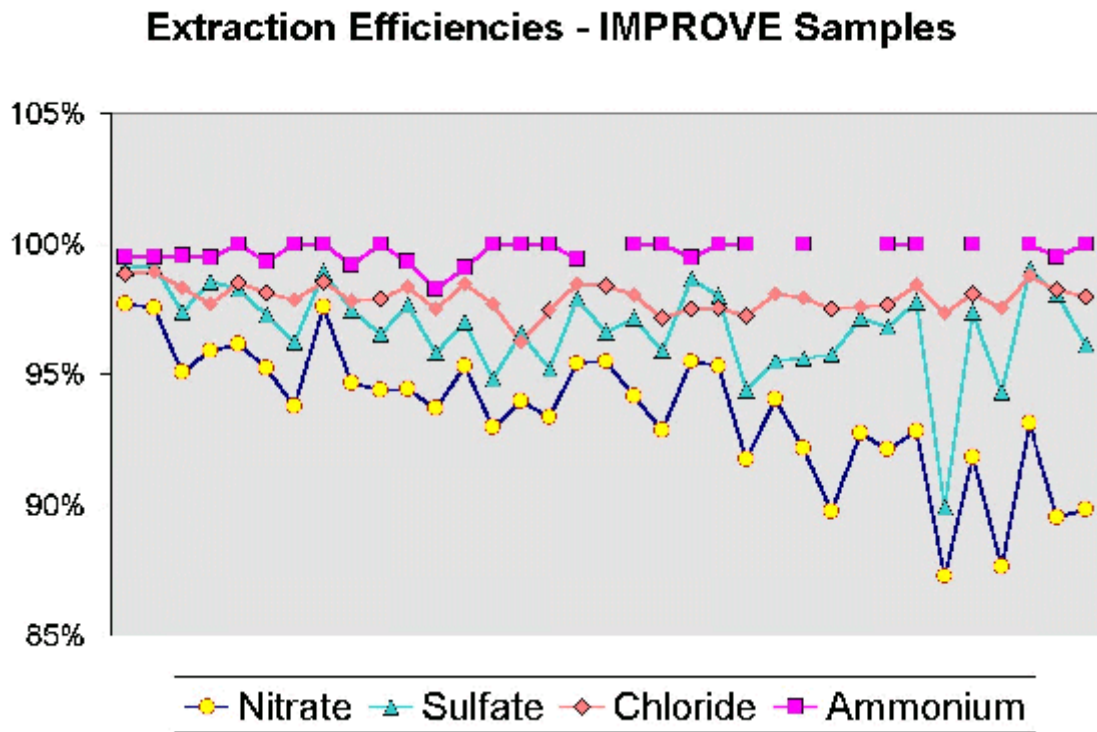
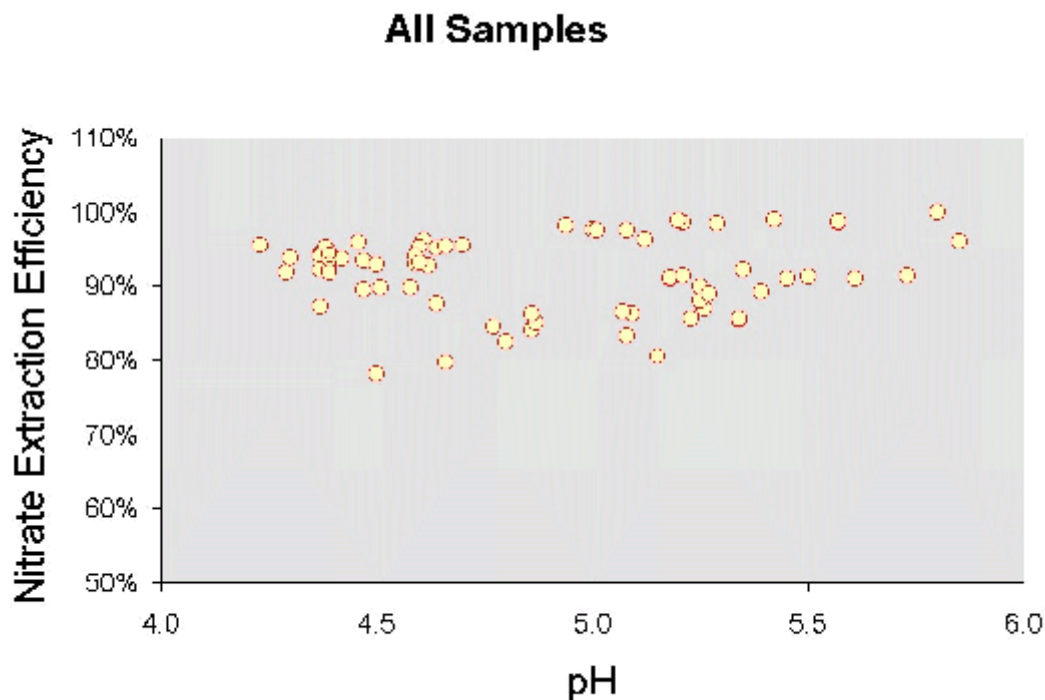


Figure 3



A suggestion was made to measure the pH of the original [first] extracts. In response to this suggestion, a 3-mL aliquot of each original extract was used to properly submerge the electrodes of the pH meter. The values of pH so determined are displayed as a scatter plot in Figure 4 and are also included in the tables at the end of this report. No significant correlation was observed between pH and extraction efficiency.

Figure 4



Conclusions

This study has shown that reasonably good extraction efficiencies can be expected for STN and IMPROVE samples using deionized water as the extraction solvent. This study utilized actual routine samples which were collected onto a Nylon® filter positioned downstream of a denuder designed to remove acid vapors. Nylon® filters which are loaded without using an effective denuder may be more difficult to extract.

This study utilized samples which had been stored in RTI's archive for approximately six months. Re-analysis of the original extracts at NAREL was critical. The excellent agreement between RTI's original results and the re-analysis at NAREL demonstrates good stability of the extracts during storage. The most significant bias between laboratories was observed in the ammonium results. The average ammonium result determined at RTI was 13% higher than the average result determined at NAREL six months later. It is interesting to note that a similar bias was observed in the ammonium results from a previous study which examined several extracts removed from archive.⁵

References

1. EPA/NAREL. 2000. "Standard Operating Procedure - Anion Analysis for the PM_{2.5} Chemical Speciation QA Program". U.S. Environmental Protection Agency. National Air and Radiation Environmental Laboratory, Montgomery, AL.
2. EPA/NAREL. 2000. "Standard Operating Procedure - Cation Analysis for the PM_{2.5} Chemical Speciation QA Program". U.S. Environmental Protection Agency. National Air and Radiation Environmental Laboratory, Montgomery, AL.
3. RTI. 2002. "Standard Operating Procedure for PM_{2.5} Anion Analysis". Research Triangle Institute, Research Triangle Park, NC.
4. RTI. 2002. "Standard Operating Procedure for PM_{2.5} Cation Analysis". Research Triangle Institute, Research Triangle Park, NC.
5. EPA/NAREL 2001. Technical Memorandum: "PM_{2.5} Speciation Trends Network Special Study". U.S. Environmental Protection Agency. National Air and Radiation Environmental Laboratory, Montgomery, AL.

Table 2

Location Name	State	Sampler	Sample Id	pH of Original Extract	Nitrate Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A141923Q	5.35	16.137	16.256	0.959	0.423	not detected	92%
Bakersfield-Calif. Ave	CA	SASS	A1493154	5.18	15.212	15.283	1.110	0.405	not detected	91%
Riverside-Rubidoux	CA	SASS	A1485236	5.45	9.350	9.342	0.695	0.213	0.022	91%
Riverside-Rubidoux	CA	SASS	A142497X	5.18	6.235	6.315	0.488	0.132	not detected	91%
El Cajon	CA	SASS	A141761Q	5.26	6.121	6.075	0.678	0.237	not detected	87%
Fresno - First Street	CA	SASS	A143979E	5.25	4.155	4.305	0.380	0.104	not detected	90%
Sacramento - Del Paso Manor	CA	SASS	A1482737	4.77	4.071	4.040	0.573	0.163	not detected	85%
Riverside-Rubidoux	CA	SASS	A1482828	5.50	3.307	3.144	0.251	0.053	not detected	91%
Seney NWR	MI	SASS	A144025D	4.66	2.361	2.457	0.460	0.164	not detected	80%
PHILA - AMS Laboratory	PA	SASS	A1494204	5.80	2.136	2.188	not detected	not detected	not detected	100%
Riverside-Rubidoux	CA	SASS	A139585J	4.86	2.119	2.184	0.325	0.087	not detected	84%
Southfield	MI	SASS	A149388L	5.42	2.110	2.180	0.023	not detected	not detected	99%
Hawthorne	UT	SASS	A1418964	5.23	2.061	2.057	0.258	0.086	not detected	86%
SER-DNR Headquarters	WI	SASS	A134930W	5.57	2.007	2.051	0.027	not detected	not detected	99%
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A1349588	4.94	2.001	2.061	0.038	not detected	not detected	98%
Rochester Fire Headquarters	NY	RPSPEC	A149804G	5.12	1.954	2.000	0.031	0.044	not detected	96%
Riverside-Rubidoux	CA	SASS	A150101X	5.20	1.928	1.985	0.023	not detected	not detected	99%
Jefferson Elementary (10th & Vine)	IA	RPSPEC	A134715R	5.21	1.888	1.947	0.027	not detected	not detected	99%
Phillips	MN	SASS	A139493G	5.21	1.888	1.999	0.190	not detected	not detected	91%
IS 52	NY	RPSPEC	A142928Z	5.29	1.824	1.937	0.030	not detected	not detected	98%
Bakersfield-California Ave	CA	SASS	A1402322	5.25	1.794	1.886	0.190	0.067	not detected	88%
Queens College	NY	RPSPEC	A145875F	4.50	1.687	1.743	0.361	0.129	not detected	78%

Table 2

Location Name	State	Sampler	Sample Id	pH of Original Extract	Nitrate Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
G.T. Craig	OH	SASS	A149636I	4.87	1.568	1.580	0.218	0.058	not detected	85%
McMillan Reservoir	DC	RAAS	A148663H	5.57	1.562	1.622	0.022	not detected	not detected	99%
Nampa NNC	ID	SASS	A140524B	5.27	1.482	1.454	0.179	not detected	not detected	89%
Wylam	AL	SASS	A1395326	5.39	1.412	1.444	0.126	0.027	0.021	89%
Camden	NJ	SASS	A149691P	4.86	1.404	1.494	0.194	0.044	not detected	86%
Cornell Elementary	IA	RPSPEC	A1459010	4.80	1.399	1.431	0.229	0.074	not detected	83%
Bakersfield-California Ave	CA	SASS	A1439341	5.34	1.369	1.459	0.153	0.061	0.034	85%
Haynes Pt.	DC	RAAS	A1459043	5.09	1.326	1.406	0.164	0.038	0.023	86%
Washington Park	IN	SASS	A1465705	5.85	1.289	1.320	not detected	not detected	0.054	96%
Blair Street	MO	RAAS	A1478015	5.73	1.288	1.257	0.092	0.026	not detected	91%
Essex	MD	RAAS	A149273B	5.07	1.142	1.164	0.148	0.033	not detected	87%
Springfield Pumping Station	IL	RAAS	A1436853	5.15	1.087	1.044	0.195	0.057	not detected	81%
Owensboro Wesleyan College	KY	SASS	A1492504	5.61	1.050	1.014	0.100	not detected	not detected	91%
Allen Park	MI	SASS	A1395144	5.34	1.047	1.058	0.128	0.029	0.022	86%
Fargo NW	ND	SASS	A141940R	5.08	1.012	1.056	0.133	0.052	0.026	83%
[BOND1] Bondville	IL	IMPROVE	N02-10322	5.00	13.644	13.631	0.319	not detected	-----	98%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10323	5.01	8.262	8.628	0.216	not detected	-----	98%
[LOST1] Lostwood	ND	IMPROVE	N02-10324	4.64	6.644	6.617	0.314	0.028	-----	95%
[WIMO1] Wichita Mountain	OK	IMPROVE	N02-10325	4.46	4.785	4.832	0.205	not detected	-----	96%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10326	4.61	4.764	4.777	0.190	not detected	-----	96%
[LOST1] Lostwood	ND	IMPROVE	N02-10327	4.38	4.519	4.464	0.223	not detected	-----	95%
[SENE1] Seney	MI	IMPROVE	N02-10328	4.30	3.651	3.573	0.219	0.018	-----	94%

Table 2

Location Name	State	Sampler	Sample Id	pH of Original Extract	Nitrate Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
[LIVO1] Livonia	IN	IMPROVE	N02-10329	5.08	3.558	3.554	0.088	not detected	-----	98%
[CADI1] Cadiz	KY	IMPROVE	N02-10330	4.39	3.320	3.420	0.193	not detected	-----	95%
[SIPS1] Sipsy	AL	IMPROVE	N02-10331	4.37	3.031	3.047	0.182	not detected	-----	94%
[UPBU1] Upper Buffalo	AR	IMPROVE	N02-10332	4.39	2.875	2.886	0.170	not detected	-----	94%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10333	4.42	2.673	2.689	0.180	not detected	-----	94%
[PUSO1] Puget Sound	WA	IMPROVE	N02-10334	4.38	2.336	2.410	0.119	not detected	-----	95%
[SAGO1] Saguario	AZ	IMPROVE	N02-10335	4.59	2.299	2.296	0.173	not detected	-----	93%
[LIVO1] Livonia	IN	IMPROVE	N02-10336	4.37	2.214	2.232	0.143	not detected	-----	94%
[BADL1] Badlands	SD	IMPROVE	N02-10337	4.47	2.037	2.055	0.146	not detected	-----	93%
[MKGO1] M.K. Goddard	PA	IMPROVE	N02-10338	4.66	2.006	2.059	0.099	not detected	-----	95%
[PHOE1] Phoenix	AZ	IMPROVE	N02-10339	4.70	1.941	2.003	0.095	not detected	-----	95%
[ACAD1] Acadia	ME	IMPROVE	N02-10340	4.39	1.822	1.853	0.114	not detected	-----	94%
[MACA1] Mammoth Cave	KY	IMPROVE	N02-10341	4.39	1.734	1.808	0.139	not detected	-----	93%
[OKEF1] Okefenokee, Wolf Island	GA	IMPROVE	N02-10342	4.23	1.598	1.658	0.078	not detected	-----	96%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10343	4.60	1.466	1.492	0.073	not detected	-----	95%
[MING1] Mingo	MO	IMPROVE	N02-10344	4.29	1.458	1.424	0.128	not detected	-----	92%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10345	4.59	1.447	1.494	0.094	not detected	-----	94%
[MOMO1] Mohawk Mountain	CT	IMPROVE	N02-10346	4.37	1.415	1.427	0.121	not detected	-----	92%
[RAFA1] San Rafael	CA	IMPROVE	N02-10347	4.51	1.392	1.399	0.123	0.036	-----	90%
[LOST1] Lostwood	ND	IMPROVE	N02-10348	4.62	1.378	1.360	0.073	0.033	-----	93%
[THRO1] Theodore Roosevelt	ND	IMPROVE	N02-10349	4.39	1.265	1.269	0.108	not detected	-----	92%
[GRSM1] Great Smoky Mtns	TN	IMPROVE	N02-10350	4.50	1.192	1.224	0.095	not detected	-----	93%

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Location Name	State	Sampler	Sample Id	pH of Original Extract	Nitrate Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10351	4.37	1.180	1.153	0.141	0.027	-----	87%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10352	4.39	1.175	1.203	0.077	0.030	-----	92%
[PINN1] Pinnacles, Ventana	CA	IMPROVE	N02-10353	4.64	1.117	1.132	0.095	0.064	-----	88%
[CABA1] Casco Bay	ME	IMPROVE	N02-10354	4.60	1.095	1.371	0.045	0.056	-----	93%
[BRMA1] Bridgton	ME	IMPROVE	N02-10355	4.47	1.090	1.194	0.084	0.056	-----	90%
[ISLE1] Isle Royale	MI	IMPROVE	N02-10356	4.58	1.062	1.081	0.085	0.038	-----	90%
			Mean	4.88	2.91	2.94	0.20	0.09	0.03	92%
			Maximum	5.85	16.137	16.256	1.110	0.423	0.54	100%
			Minimum	4.23	1.012	1.014	0.022	0.018	0.21	78%
			n	72	72	72	70	35	7	72

Table 3

Location Name	State	Sampler	Sample Id	pH of Original Extract	Sulfate Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A141923Q	5.35	1.086	1.102	not detected	0.019	not detected	98%
Bakersfield-Calif. Ave	CA	SASS	A1493154	5.18	2.262	2.350	0.063	0.041	not detected	96%
Riverside-Rubidoux	CA	SASS	A1485236	5.45	0.732	0.732	not detected	not detected	not detected	100%
Riverside-Rubidoux	CA	SASS	A142497X	5.18	1.959	1.964	0.055	not detected	not detected	97%
El Cajon	CA	SASS	A141761Q	5.26	2.669	2.685	0.091	0.037	not detected	95%
Fresno - First Street	CA	SASS	A143979E	5.25	0.711	0.729	0.027	not detected	not detected	96%
Sacramento - Del Paso Manor	CA	SASS	A1482737	4.77	0.694	0.720	0.058	0.022	not detected	90%
Riverside-Rubidoux	CA	SASS	A1482828	5.50	0.259	0.251	0.000	not detected	not detected	low capture
Seney NWR	MI	SASS	A144025D	4.66	1.230	1.248	0.140	0.073	not detected	85%
PHILA - AMS Laboratory	PA	SASS	A1494204	5.80	1.605	1.628	not detected	not detected	not detected	100%
Riverside-Rubidoux	CA	SASS	A139585J	4.86	0.702	0.746	0.061	not detected	not detected	92%
Southfield	MI	SASS	A149388L	5.42	1.589	1.617	not detected	not detected	not detected	100%
Hawthorne	UT	SASS	A1418964	5.23	0.375	0.376	0.016	not detected	not detected	low capture
SER-DNR Headquarters	WI	SASS	A134930W	5.57	1.022	1.049	not detected	not detected	not detected	100%
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A1349588	4.94	0.788	0.869	not detected	not detected	not detected	100%
Rochester Fire Headquarters	NY	RPSPEC	A149804G	5.12	2.181	2.211	not detected	not detected	not detected	100%
Riverside-Rubidoux	CA	SASS	A150101X	5.20	0.592	0.613	not detected	not detected	not detected	100%
Jefferson Elementary (10th & Vine)	IA	RPSPEC	A134715R	5.21	1.811	1.892	not detected	not detected	not detected	100%
Phillips	MN	SASS	A139493G	5.21	1.172	1.191	0.039	not detected	not detected	97%
IS 52	NY	RPSPEC	A142928Z	5.29	2.746	2.768	0.018	not detected	not detected	99%
Bakersfield-California Ave	CA	SASS	A1402322	5.25	0.755	0.776	not detected	not detected	not detected	100%
Queens College	NY	RPSPEC	A145875F	4.50	2.197	2.281	0.286	0.117	not detected	85%

Table 3

Location Name	State	Sampler	Sample Id	pH of Original Extract	Sulfate Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
G.T. Craig	OH	SASS	A149636I	4.87	2.700	2.700	0.152	0.033	not detected	94%
McMillan Reservoir	DC	RAAS	A148663H	5.57	1.405	1.432	not detected	not detected	not detected	100%
Nampa NNC	ID	SASS	A140524B	5.27	0.485	0.482	0.016	not detected	not detected	low capture
Wylam	AL	SASS	A1395326	5.39	2.765	2.831	0.078	not detected	not detected	97%
Camden	NJ	SASS	A149691P	4.86	3.203	3.269	0.145	not detected	not detected	96%
Cornell Elementary	IA	RPSPEC	A1459010	4.80	3.974	3.974	0.240	0.055	not detected	93%
Bakersfield-California Ave	CA	SASS	A1439341	5.34	0.350	0.355	not detected	not detected	not detected	low capture
Haynes Pt.	DC	RAAS	A1459043	5.09	2.500	2.521	0.103	not detected	not detected	96%
Washington Park	IN	SASS	A1465705	5.85	1.159	1.176	not detected	not detected	not detected	100%
Blair Street	MO	RAAS	A1478015	5.73	1.117	1.129	0.032	not detected	not detected	97%
Essex	MD	RAAS	A149273B	5.07	2.789	2.784	0.104	not detected	not detected	96%
Springfield Pumping Station	IL	RAAS	A1436853	5.15	0.456	0.469	0.049	0.025	not detected	low capture
Owensboro - KY Wesleyan College	KY	SASS	A1492504	5.61	0.597	0.574	0.028	not detected	not detected	95%
Allen Park	MI	SASS	A1395144	5.34	0.586	0.629	0.037	not detected	not detected	94%
Fargo NW	ND	SASS	A141940R	5.08	0.955	0.980	0.060	not detected	not detected	94%
[BOND1] Bondville	IL	IMPROVE	N02-10322	5.00	15.480	14.958	0.138	not detected	-----	99%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10323	5.01	7.437	7.218	0.063	not detected	-----	99%
[LOST1] Lostwood	ND	IMPROVE	N02-10324	4.64	4.054	3.894	0.104	not detected	-----	97%
[WIMO1] Wichita Mountain	OK	IMPROVE	N02-10325	4.46	10.404	10.115	0.149	not detected	-----	99%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10326	4.61	3.254	3.204	0.057	not detected	-----	98%
[LOST1] Lostwood	ND	IMPROVE	N02-10327	4.38	2.226	2.212	0.062	not detected	-----	97%
[SENE1] Seney	MI	IMPROVE	N02-10328	4.30	2.311	2.204	0.086	not detected	-----	96%

Table 3

Location Name	State	Sampler	Sample Id	pH of Original Extract	Sulfate Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
[LIVO1] Livonia	IN	IMPROVE	N02-10329	5.08	2.524	2.503	0.028	not detected	-----	99%
[CADI1] Cadiz	KY	IMPROVE	N02-10330	4.39	3.871	3.747	0.097	not detected	-----	97%
[SIPS1] Sipsey	AL	IMPROVE	N02-10331	4.37	2.503	2.425	0.087	not detected	-----	97%
[UPBU1] Upper Buffalo	AR	IMPROVE	N02-10332	4.39	3.823	3.725	0.090	not detected	-----	98%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10333	4.42	1.612	1.556	0.068	not detected	-----	96%
[PUSO1] Puget Sound	WA	IMPROVE	N02-10334	4.38	2.064	2.083	0.064	not detected	-----	97%
[SAGO1] Saguaro	AZ	IMPROVE	N02-10335	4.59	0.935	0.903	0.049	not detected	-----	95%
[LIVO1] Livonia	IN	IMPROVE	N02-10336	4.37	3.325	3.193	0.113	not detected	-----	97%
[BADL1] Badlands	SD	IMPROVE	N02-10337	4.47	1.332	1.289	0.065	not detected	-----	95%
[MKGO1] M.K. Goddard	PA	IMPROVE	N02-10338	4.66	2.843	2.840	0.062	not detected	-----	98%
[PHOE1] Phoenix	AZ	IMPROVE	N02-10339	4.70	0.952	0.941	0.033	not detected	-----	97%
[ACAD1] Acadia	ME	IMPROVE	N02-10340	4.39	4.051	3.980	0.116	not detected	-----	97%
[MACA1] Mammoth Cave	KY	IMPROVE	N02-10341	4.39	2.792	2.737	0.117	not detected	-----	96%
[OKEF1] Okefenokee, Wolf Island	GA	IMPROVE	N02-10342	4.23	14.599	14.226	0.196	not detected	-----	99%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10343	4.60	3.708	3.601	0.073	not detected	-----	98%
[MING1] Mingo	MO	IMPROVE	N02-10344	4.29	1.833	1.735	0.103	not detected	-----	94%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10345	4.59	0.601	0.597	0.028	not detected	-----	96%
[MOMO1] Mohawk Mountain	CT	IMPROVE	N02-10346	4.37	2.688	2.606	0.120	not detected	-----	96%
[RAFA1] San Rafael	CA	IMPROVE	N02-10347	4.51	1.897	1.828	0.081	not detected	-----	96%
[LOST1] Lostwood	ND	IMPROVE	N02-10348	4.62	1.810	1.745	0.051	not detected	-----	97%
[THRO1] Theodore Roosevelt	ND	IMPROVE	N02-10349	4.39	4.196	4.050	0.133	not detected	-----	97%
[GRSM1] Great Smoky Mtns	TN	IMPROVE	N02-10350	4.50	2.692	2.603	0.059	not detected	-----	98%

Table 3

Location Name	State	Sampler	Sample Id	pH of Original Extract	Sulfate Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10351	4.37	0.807	0.716	0.080	not detected	-----	90%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10352	4.39	5.023	4.920	0.132	not detected	-----	97%
[PINN1] Pinnacles, Ventana	CA	IMPROVE	N02-10353	4.64	0.771	0.753	0.045	not detected	-----	94%
[CABA1] Casco Bay	ME	IMPROVE	N02-10354	4.60	3.400	3.975	0.038	not detected	-----	99%
[BRMA1] Bridgton	ME	IMPROVE	N02-10355	4.47	6.825	6.645	0.130	not detected	-----	98%
[ISLE1] Isle Royale	MI	IMPROVE	N02-10356	4.58	1.710	1.665	0.067	not detected	-----	96%
			Mean	4.88	2.56	2.53	0.08	0.05	-----	97%
			Maximum	5.85	15.480	14.958	0.286	0.117	-----	100%
			Minimum	4.23	0.259	0.251	0.000	0.019	-----	85%
			n	72	72	72	59	9	0	67

Table 4

Location Name	State	Sampler	Sample Id	pH of Original Extract	Chloride Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
[BOND1] Bondville	IL	IMPROVE	N02-10322	5.00	1.658	1.643	0.020	not detected	-----	99%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10323	5.01	1.639	1.635	0.018	not detected	-----	99%
[LOST1] Lostwood	ND	IMPROVE	N02-10324	4.64	1.085	1.093	0.019	not detected	-----	98%
[WIMO1] Wichita Mountain	OK	IMPROVE	N02-10325	4.46	0.809	0.782	0.013	0.006	-----	98%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10326	4.61	0.768	0.763	0.012	not detected	-----	98%
[LOST1] Lostwood	ND	IMPROVE	N02-10327	4.38	1.138	1.163	0.022	not detected	-----	98%
[SENE1] Seney	MI	IMPROVE	N02-10328	4.30	0.957	0.944	0.021	not detected	-----	98%
[LIVO1] Livonia	IN	IMPROVE	N02-10329	5.08	0.777	0.779	0.012	not detected	-----	99%
[CADI1] Cadiz	KY	IMPROVE	N02-10330	4.39	0.981	1.017	0.023	not detected	-----	98%
[SIPS1] Sipsey	AL	IMPROVE	N02-10331	4.37	0.659	0.662	0.014	not detected	-----	98%
[UPBU1] Upper Buffalo	AR	IMPROVE	N02-10332	4.39	0.796	0.798	0.013	not detected	-----	98%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10333	4.42	1.484	1.472	0.032	0.006	-----	97%
[PUSO1] Puget Sound	WA	IMPROVE	N02-10334	4.38	1.670	1.677	0.027	not detected	-----	98%
[SAGO1] Saguaro	AZ	IMPROVE	N02-10335	4.59	1.086	1.076	0.025	not detected	-----	98%
[LIVO1] Livonia	IN	IMPROVE	N02-10336	4.37	1.073	1.056	0.036	0.005	-----	96%
[BADL1] Badlands	SD	IMPROVE	N02-10337	4.47	0.521	0.519	0.014	not detected	-----	97%
[MKGO1] M.K. Goddard	PA	IMPROVE	N02-10338	4.66	1.145	1.153	0.018	not detected	-----	98%
[PHOE1] Phoenix	AZ	IMPROVE	N02-10339	4.70	1.135	1.190	0.019	not detected	-----	98%
[ACAD1] Acadia	ME	IMPROVE	N02-10340	4.39	1.565	1.583	0.031	not detected	-----	98%
[MACA1] Mammoth Cave	KY	IMPROVE	N02-10341	4.39	0.726	0.751	0.022	not detected	-----	97%
[OKEF1] Okefenokee, Wolf Island	GA	IMPROVE	N02-10342	4.23	0.756	0.727	0.013	0.005	-----	98%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10343	4.60	0.913	0.903	0.016	0.007	-----	98%

Table 4

Location Name	State	Sampler	Sample Id	pH of Original Extract	Chloride Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
[MING1] Mingo	MO	IMPROVE	N02-10344	4.29	1.126	1.108	0.031	not detected	-----	97%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10345	4.59	1.034	1.054	0.020	not detected	-----	98%
[MOMO1] Mohawk Mountain	CT	IMPROVE	N02-10346	4.37	0.793	0.796	0.017	not detected	-----	98%
[RAFA1] San Rafael	CA	IMPROVE	N02-10347	4.51	1.694	1.698	0.038	0.006	-----	98%
[LOST1] Lostwood	ND	IMPROVE	N02-10348	4.62	1.078	1.094	0.017	0.010	-----	98%
[THRO1] Theodore Roosevelt	ND	IMPROVE	N02-10349	4.39	1.047	1.059	0.020	0.005	-----	98%
[GRSM1] Great Smoky Mtns	TN	IMPROVE	N02-10350	4.50	1.001	0.994	0.016	not detected	-----	98%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10351	4.37	1.210	1.215	0.033	not detected	-----	97%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10352	4.39	1.009	0.998	0.020	not detected	-----	98%
[PINN1] Pinnacles, Ventana	CA	IMPROVE	N02-10353	4.64	1.460	1.461	0.031	0.006	-----	98%
[CABA1] Casco Bay	ME	IMPROVE	N02-10354	4.60	1.247	2.327	0.029	not detected	-----	99%
[BRMA1] Bridgton	ME	IMPROVE	N02-10355	4.47	1.066	1.167	0.021	not detected	-----	98%
[ISLE1] Isle Royale	MI	IMPROVE	N02-10356	4.58	1.072	1.066	0.022	not detected	-----	98%
			Mean	4.88	1.09	1.13	0.02	0.01	-----	98%
			Maximum	5.85	1.694	2.327	0.038	0.010	-----	99%
			Minimum	4.23	0.521	0.519	0.012	0.005	-----	96%
			n	72	35	35	35	9	0	35

Table 5

Location Name	State	Sampler	Sample Id	pH of Original Extract	Nitrite Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
[BOND1] Bondville	IL	IMPROVE	N02-10322	5.00	0.003	0.013	not detected	not detected	-----	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10323	5.01	0.203	0.075	not detected	0.017	-----	low capture
[LOST1] Lostwood	ND	IMPROVE	N02-10324	4.64	0.026	not detected	not detected	0.014	-----	low capture
[WIMO1] Wichita Mountain	OK	IMPROVE	N02-10325	4.46	0.034	0.014	not detected	not detected	-----	low capture
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10326	4.61	0.027	0.009	not detected	0.014	-----	low capture
[LOST1] Lostwood	ND	IMPROVE	N02-10327	4.38	0.033	not detected	not detected	not detected	-----	low capture
[SENE1] Seney	MI	IMPROVE	N02-10328	4.30	0.026	not detected	not detected	0.015	-----	low capture
[LIVO1] Livonia	IN	IMPROVE	N02-10329	5.08	0.027	not detected	not detected	not detected	-----	low capture
[CADI1] Cadiz	KY	IMPROVE	N02-10330	4.39	0.039	0.012	not detected	not detected	-----	low capture
[SIPS1] Sipsey	AL	IMPROVE	N02-10331	4.37	0.024	not detected	not detected	not detected	-----	low capture
[UPBU1] Upper Buffalo	AR	IMPROVE	N02-10332	4.39	0.035	not detected	not detected	not detected	-----	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10333	4.42	0.031	not detected	not detected	not detected	-----	low capture
[PUSO1] Puget Sound	WA	IMPROVE	N02-10334	4.38	0.033	not detected	not detected	not detected	-----	low capture
[SAGO1] Saguaro	AZ	IMPROVE	N02-10335	4.59	0.000	not detected	not detected	not detected	-----	low capture
[LIVO1] Livonia	IN	IMPROVE	N02-10336	4.37	0.029	not detected	not detected	not detected	-----	low capture
[BADL1] Badlands	SD	IMPROVE	N02-10337	4.47	0.029	not detected	not detected	not detected	-----	low capture
[MKGO1] M.K. Goddard	PA	IMPROVE	N02-10338	4.66	0.033	0.011	not detected	not detected	-----	low capture
[PHOE1] Phoenix	AZ	IMPROVE	N02-10339	4.70	0.021	not detected	not detected	not detected	-----	low capture
[ACAD1] Acadia	ME	IMPROVE	N02-10340	4.39	0.036	not detected	not detected	0.026	-----	low capture
[MACA1] Mammoth Cave	KY	IMPROVE	N02-10341	4.39	0.028	not detected	not detected	0.010	-----	low capture
[OKEF1] Okefenokee, Wolf Island	GA	IMPROVE	N02-10342	4.23	0.053	0.019	not detected	0.019	-----	low capture
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10343	4.60	0.029	not detected	not detected	not detected	-----	low capture

Table 5

Location Name	State	Sampler	Sample Id	pH of Original Extract	Nitrite Concentration (ug/mL)					Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	Third Extraction (Buffer)	Fourth Extraction (Buffer)	
[MING1] Mingo	MO	IMPROVE	N02-10344	4.29	0.023	not detected	not detected	not detected	-----	low capture
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10345	4.59	0.039	not detected	not detected	0.018	-----	low capture
[MOMO1] Mohawk Mountain	CT	IMPROVE	N02-10346	4.37	0.035	not detected	0.025	0.076	-----	low capture
[RAFA1] San Rafael	CA	IMPROVE	N02-10347	4.51	0.000	not detected	0.032	0.127	-----	low capture
[LOST1] Lostwood	ND	IMPROVE	N02-10348	4.62	0.030	not detected	0.017	0.112	-----	low capture
[THRO1] Theodore Roosevelt	ND	IMPROVE	N02-10349	4.39	0.033	0.011	0.075	0.054	-----	low capture
[GRSM1] Great Smoky Mtns	TN	IMPROVE	N02-10350	4.50	0.035	not detected	0.120	0.086	-----	low capture
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10351	4.37	0.000	not detected	0.079	0.068	-----	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10352	4.39	0.026	not detected	0.013	0.104	-----	low capture
[PINN1] Pinnacles, Ventana	CA	IMPROVE	N02-10353	4.64	0.000	not detected	0.047	0.331	-----	low capture
[CABA1] Casco Bay	ME	IMPROVE	N02-10354	4.60	0.028	not detected	0.010	0.243	-----	low capture
[BRMA1] Bridgton	ME	IMPROVE	N02-10355	4.47	0.033	0.013	0.067	0.284	-----	low capture
[ISLE1] Isle Royale	MI	IMPROVE	N02-10356	4.58	0.030	not detected	0.033	0.132	-----	low capture
			Mean	4.88	0.03	0.02	0.05	0.09	-----	-----
			Maximum	5.85	0.203	0.075	0.120	0.331	-----	-----
			Minimum	4.23	0.000	0.009	0.010	0.010	-----	-----
			n	72	35	9	11	19	0	0

Table 6

Location Name	State	Sampler	Sample Id	pH of Original Extract	Ammonium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A141923Q	5.35	4.780	4.496	0.030	99%
Bakersfield-Calif. Ave	CA	SASS	A1493154	5.18	5.171	4.664	0.032	99%
Riverside-Rubidoux	CA	SASS	A1485236	5.45	2.820	2.455	0.017	99%
Riverside-Rubidoux	CA	SASS	A142497X	5.18	2.337	2.211	0.021	99%
El Cajon	CA	SASS	A141761Q	5.26	2.379	2.196	0.014	99%
Fresno - First Street	CA	SASS	A143979E	5.25	0.984	0.973	0.013	99%
Sacramento - Del Paso Manor	CA	SASS	A1482737	4.77	0.795	0.744	0.009	99%
Riverside-Rubidoux	CA	SASS	A1482828	5.50	0.668	0.616	not detected	100%
Seney NWR	MI	SASS	A144025D	4.66	0.503	0.471	0.008	low capture
PHILA - AMS Laboratory	PA	SASS	A1494204	5.80	1.009	0.941	0.010	99%
Riverside-Rubidoux	CA	SASS	A139585J	4.86	0.497	0.473	not detected	low capture
Southfield	MI	SASS	A149388L	5.42	0.974	0.915	0.009	99%
Hawthorne	UT	SASS	A1418964	5.23	0.309	0.203	not detected	low capture
SER-DNR Headquarters	WI	SASS	A134930W	5.57	0.620	0.569	not detected	100%
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A1349588	4.94	0.591	0.410	not detected	low capture
Rochester Fire Headquarters	NY	RPSPEC	A149804G	5.12	0.941	0.904	0.009	99%
Riverside-Rubidoux	CA	SASS	A150101X	5.20	0.341	0.276	not detected	low capture
Jefferson Elementary (10th & Vine)	IA	RPSPEC	A134715R	5.21	0.792	0.679	0.007	99%
Phillips	MN	SASS	A139493G	5.21	0.639	0.592	not detected	100%
IS 52	NY	RPSPEC	A142928Z	5.29	1.261	1.296	0.014	99%
Bakersfield-California Ave	CA	SASS	A1402322	5.25	0.438	0.422	not detected	low capture
Queens College	NY	RPSPEC	A145875F	4.50	0.897	0.576	0.008	99%

Table 6

Location Name	State	Sampler	Sample Id	pH of Original Extract	Ammonium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
G.T. Craig	OH	SASS	A149636I	4.87	1.081	1.025	0.008	99%
McMillan Reservoir	DC	RAAS	A148663H	5.57	0.626	0.618	0.010	98%
Nampa NNC	ID	SASS	A140524B	5.27	0.299	0.258	not detected	low capture
Wylam	AL	SASS	A1395326	5.39	0.481	0.381	not detected	low capture
Camden	NJ	SASS	A149691P	4.86	1.300	1.246	0.012	99%
Cornell Elementary	IA	RPSPEC	A1459010	4.80	1.546	1.419	0.013	99%
Bakersfield-California Ave	CA	SASS	A1439341	5.34	0.225	0.211	not detected	low capture
Haynes Pt.	DC	RAAS	A1459043	5.09	1.053	0.999	0.012	99%
Washington Park	IN	SASS	A1465705	5.85	0.563	0.528	not detected	100%
Blair Street	MO	RAAS	A1478015	5.73	0.495	0.441	not detected	low capture
Essex	MD	RAAS	A149273B	5.07	1.085	1.013	0.009	99%
Springfield Pumping Station	IL	RAAS	A1436853	5.15	0.323	0.288	not detected	low capture
Owensboro - KY Wesleyan College	KY	SASS	A1492504	5.61	0.205	0.157	not detected	low capture
Allen Park	MI	SASS	A1395144	5.34	0.244	0.189	not detected	low capture
Fargo NW	ND	SASS	A141940R	5.08	0.273	0.260	not detected	low capture
[BOND1] Bondville	IL	IMPROVE	N02-10322	5.00	-----	9.127	0.047	99%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10323	5.01	-----	3.637	0.019	99%
[LOST1] Lostwood	ND	IMPROVE	N02-10324	4.64	-----	2.803	0.013	100%
[WIMO1] Wichita Mountain	OK	IMPROVE	N02-10325	4.46	-----	4.613	0.026	99%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10326	4.61	-----	2.169	not detected	100%
[LOST1] Lostwood	ND	IMPROVE	N02-10327	4.38	-----	1.500	0.011	99%
[SENE1] Seney	MI	IMPROVE	N02-10328	4.30	-----	1.290	not detected	100%

Table 6

Location Name	State	Sampler	Sample Id	pH of Original Extract	Ammonium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
[LIVO1] Livonia	IN	IMPROVE	N02-10329	5.08	-----	1.278	not detected	100%
[CADI1] Cadiz	KY	IMPROVE	N02-10330	4.39	-----	1.608	0.013	99%
[SIPS1] Sipsey	AL	IMPROVE	N02-10331	4.37	-----	1.111	not detected	100%
[UPBU1] Upper Buffalo	AR	IMPROVE	N02-10332	4.39	-----	1.643	0.012	99%
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10333	4.42	-----	0.529	0.009	98%
[PUSO1] Puget Sound	WA	IMPROVE	N02-10334	4.38	-----	1.072	0.010	99%
[SAGO1] Saguaro	AZ	IMPROVE	N02-10335	4.59	-----	0.784	not detected	100%
[LIVO1] Livonia	IN	IMPROVE	N02-10336	4.37	-----	1.347	not detected	100%
[BADL1] Badlands	SD	IMPROVE	N02-10337	4.47	-----	0.504	not detected	100%
[MKGO1] M.K. Goddard	PA	IMPROVE	N02-10338	4.66	-----	1.333	0.008	99%
[PHOE1] Phoenix	AZ	IMPROVE	N02-10339	4.70	-----	0.472	not detected	low capture
[ACAD1] Acadia	ME	IMPROVE	N02-10340	4.39	-----	0.860	not detected	100%
[MACA1] Mammoth Cave	KY	IMPROVE	N02-10341	4.39	-----	0.859	not detected	100%
[OKEF1] Okefenokee, Wolf Island	GA	IMPROVE	N02-10342	4.23	-----	4.006	0.022	99%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10343	4.60	-----	1.427	not detected	100%
[MING1] Mingo	MO	IMPROVE	N02-10344	4.29	-----	0.623	not detected	100%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10345	4.59	-----	0.371	not detected	low capture
[MOMO1] Mohawk Mountain	CT	IMPROVE	N02-10346	4.37	-----	0.813	not detected	100%
[RAFA1] San Rafael	CA	IMPROVE	N02-10347	4.51	-----	0.442	not detected	low capture
[LOST1] Lostwood	ND	IMPROVE	N02-10348	4.62	-----	0.495	not detected	low capture
[THRO1] Theodore Roosevelt	ND	IMPROVE	N02-10349	4.39	-----	1.408	not detected	100%
[GRSM1] Great Smoky Mtns	TN	IMPROVE	N02-10350	4.50	1.095	1.045	not detected	100%

Table 6

Location Name	State	Sampler	Sample Id	pH of Original Extract	Ammonium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10351	4.37	-----	0.061	not detected	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10352	4.39	-----	1.408	not detected	100%
[PINN1] Pinnacles, Ventana	CA	IMPROVE	N02-10353	4.64	-----	0.095	not detected	low capture
[CABA1] Casco Bay	ME	IMPROVE	N02-10354	4.60	-----	0.893	not detected	100%
[BRMA1] Bridgton	ME	IMPROVE	N02-10355	4.47	-----	2.389	0.012	99%
[ISLE1] Isle Royale	MI	IMPROVE	N02-10356	4.58	-----	0.629	not detected	100%
			Mean	4.88	1.07	1.26	0.01	99%
			Maximum	5.85	5.171	9.127	0.047	100%
			Minimum	4.23	0.205	0.061	0.007	98%
			n	72	38	72	32	52

Table 7

Location Name	State	Sampler	Sample Id	pH of Original Extract	Potassium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A141923Q	5.35	0.059	0.086	not detected	low capture
Bakersfield-Calif. Ave	CA	SASS	A1493154	5.18	0.037	0.057	not detected	low capture
Riverside-Rubidoux	CA	SASS	A1485236	5.45	0.071	0.079	not detected	low capture
Riverside-Rubidoux	CA	SASS	A142497X	5.18	0.000	0.039	not detected	low capture
El Cajon	CA	SASS	A141761Q	5.26	0.028	0.034	not detected	low capture
Fresno - First Street	CA	SASS	A143979E	5.25	0.039	0.056	not detected	low capture
Sacramento - Del Paso Manor	CA	SASS	A1482737	4.77	0.072	0.080	not detected	low capture
Riverside-Rubidoux	CA	SASS	A1482828	5.50	0.000	0.030	not detected	low capture
Seney NWR	MI	SASS	A144025D	4.66	0.030	0.030	not detected	low capture
PHILA - AMS Laboratory	PA	SASS	A1494204	5.80	0.012	0.022	not detected	low capture
Riverside-Rubidoux	CA	SASS	A139585J	4.86	0.000	0.026	not detected	low capture
Southfield	MI	SASS	A149388L	5.42	0.018	0.034	not detected	low capture
Hawthorne	UT	SASS	A1418964	5.23	0.018	0.024	not detected	low capture
SER-DNR Headquarters	WI	SASS	A134930W	5.57	0.020	0.032	not detected	low capture
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A1349588	4.94	0.063	0.077	not detected	low capture
Rochester Fire Headquarters	NY	RPSPEC	A149804G	5.12	0.020	0.031	not detected	low capture
Riverside-Rubidoux	CA	SASS	A150101X	5.20	0.047	0.050	not detected	low capture
Jefferson Elementary (10th & Vine)	IA	RPSPEC	A134715R	5.21	0.017	0.024	not detected	low capture
Phillips	MN	SASS	A139493G	5.21	0.046	0.066	not detected	low capture
IS 52	NY	RPSPEC	A142928Z	5.29	0.022	0.038	not detected	low capture
Bakersfield-California Ave	CA	SASS	A1402322	5.25	0.057	0.071	not detected	low capture
Queens College	NY	RPSPEC	A145875F	4.50	0.036	0.022	not detected	low capture

Table 7

Location Name	State	Sampler	Sample Id	pH of Original Extract	Potassium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
G.T. Craig	OH	SASS	A149636I	4.87	0.048	0.067	not detected	low capture
McMillan Reservoir	DC	RAAS	A148663H	5.57	0.020	0.047	not detected	low capture
Nampa NNC	ID	SASS	A140524B	5.27	0.068	0.088	not detected	low capture
Wylam	AL	SASS	A1395326	5.39	0.051	0.063	not detected	low capture
Camden	NJ	SASS	A149691P	4.86	0.028	0.040	not detected	low capture
Cornell Elementary	IA	RPSPEC	A1459010	4.80	0.048	0.061	not detected	low capture
Bakersfield-California Ave	CA	SASS	A1439341	5.34	0.022	0.040	not detected	low capture
Haynes Pt.	DC	RAAS	A1459043	5.09	0.052	0.065	not detected	low capture
Washington Park	IN	SASS	A1465705	5.85	0.022	0.033	not detected	low capture
Blair Street	MO	RAAS	A1478015	5.73	0.040	0.040	not detected	low capture
Essex	MD	RAAS	A149273B	5.07	0.061	0.082	not detected	low capture
Springfield Pumping Station	IL	RAAS	A1436853	5.15	0.115	0.122	not detected	low capture
Owensboro - KY Wesleyan College	KY	SASS	A1492504	5.61	0.036	0.041	not detected	low capture
Allen Park	MI	SASS	A1395144	5.34	0.018	0.035	not detected	low capture
Fargo NW	ND	SASS	A141940R	5.08	0.232	0.262	not detected	low capture
[BOND1] Bondville	IL	IMPROVE	N02-10322	5.00	-----	0.449	0.013	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10323	5.01	-----	3.948	0.029	99%
[LOST1] Lostwood	ND	IMPROVE	N02-10324	4.64	-----	0.122	not detected	low capture
[WIMO1] Wichita Mountain	OK	IMPROVE	N02-10325	4.46	-----	0.244	not detected	low capture
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10326	4.61	-----	0.187	not detected	low capture
[LOST1] Lostwood	ND	IMPROVE	N02-10327	4.38	-----	0.410	not detected	low capture
[SENE1] Seney	MI	IMPROVE	N02-10328	4.30	-----	0.137	not detected	low capture

Table 7

Location Name	State	Sampler	Sample Id	pH of Original Extract	Potassium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
[LIVO1] Livonia	IN	IMPROVE	N02-10329	5.08	-----	1.442	not detected	100%
[CADI1] Cadiz	KY	IMPROVE	N02-10330	4.39	-----	0.173	not detected	low capture
[SIPS1] Sipsey	AL	IMPROVE	N02-10331	4.37	-----	0.188	not detected	low capture
[UPBU1] Upper Buffalo	AR	IMPROVE	N02-10332	4.39	-----	0.217	not detected	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10333	4.42	-----	0.123	not detected	low capture
[PUSO1] Puget Sound	WA	IMPROVE	N02-10334	4.38	-----	0.255	not detected	low capture
[SAGO1] Saguaro	AZ	IMPROVE	N02-10335	4.59	-----	0.101	not detected	low capture
[LIVO1] Livonia	IN	IMPROVE	N02-10336	4.37	-----	0.147	not detected	low capture
[BADL1] Badlands	SD	IMPROVE	N02-10337	4.47	-----	0.105	not detected	low capture
[MKGO1] M.K. Goddard	PA	IMPROVE	N02-10338	4.66	-----	0.363	not detected	low capture
[PHOE1] Phoenix	AZ	IMPROVE	N02-10339	4.70	-----	0.163	not detected	low capture
[ACAD1] Acadia	ME	IMPROVE	N02-10340	4.39	-----	0.176	not detected	low capture
[MACA1] Mammoth Cave	KY	IMPROVE	N02-10341	4.39	-----	0.135	not detected	low capture
[OKEF1] Okefenokee, Wolf Island	GA	IMPROVE	N02-10342	4.23	-----	1.495	not detected	100%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10343	4.60	-----	0.183	not detected	low capture
[MING1] Mingo	MO	IMPROVE	N02-10344	4.29	-----	0.100	not detected	low capture
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10345	4.59	-----	0.192	not detected	low capture
[MOMO1] Mohawk Mountain	CT	IMPROVE	N02-10346	4.37	-----	0.107	not detected	low capture
[RAFA1] San Rafael	CA	IMPROVE	N02-10347	4.51	-----	0.159	not detected	low capture
[LOST1] Lostwood	ND	IMPROVE	N02-10348	4.62	-----	0.362	not detected	low capture
[THRO1] Theodore Roosevelt	ND	IMPROVE	N02-10349	4.39	-----	0.130	not detected	low capture
[GRSM1] Great Smoky Mtns	TN	IMPROVE	N02-10350	4.50	-----	0.172	not detected	low capture

Table 7

Location Name	State	Sampler	Sample Id	pH of Original Extract	Potassium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10351	4.37	-----	0.108	not detected	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10352	4.39	-----	0.264	not detected	low capture
[PINN1] Pinnacles, Ventana	CA	IMPROVE	N02-10353	4.64	-----	0.124	not detected	low capture
[CABA1] Casco Bay	ME	IMPROVE	N02-10354	4.60	-----	0.505	not detected	100%
[BRMA1] Bridgton	ME	IMPROVE	N02-10355	4.47	-----	0.187	not detected	low capture
[ISLE1] Isle Royale	MI	IMPROVE	N02-10356	4.58	-----	0.134	not detected	low capture
			Mean	4.88	0.04	0.21	0.02	100%
			Maximum	5.85	0.232	3.948	0.029	100%
			Minimum	4.23	0.000	0.022	0.013	99%
			n	72	37	72	2	4

Table 8

Location Name	State	Sampler	Sample Id	pH of Original Extract	Sodium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A141923Q	5.35	0.347	0.347	not detected	low capture
Bakersfield-Calif. Ave	CA	SASS	A1493154	5.18	0.125	0.126	0.008	low capture
Riverside-Rubidoux	CA	SASS	A1485236	5.45	0.166	0.170	0.011	low capture
Riverside-Rubidoux	CA	SASS	A142497X	5.18	0.174	0.186	0.007	low capture
El Cajon	CA	SASS	A141761Q	5.26	0.324	0.323	0.010	low capture
Fresno - First Street	CA	SASS	A143979E	5.25	0.255	0.249	0.011	low capture
Sacramento - Del Paso Manor	CA	SASS	A1482737	4.77	0.354	0.371	0.009	low capture
Riverside-Rubidoux	CA	SASS	A1482828	5.50	0.205	0.224	not detected	low capture
Seney NWR	MI	SASS	A144025D	4.66	0.166	0.181	not detected	low capture
PHILA - AMS Laboratory	PA	SASS	A1494204	5.80	0.637	0.613	0.011	98%
Riverside-Rubidoux	CA	SASS	A139585J	4.86	0.112	0.130	not detected	low capture
Southfield	MI	SASS	A149388L	5.42	0.459	0.466	0.011	low capture
Hawthorne	UT	SASS	A1418964	5.23	0.325	0.335	not detected	low capture
SER-DNR Headquarters	WI	SASS	A134930W	5.57	0.659	0.661	0.012	98%
Bakersfield-Calif. Ave (Collocated)	CA	SASS	A1349588	4.94	0.596	0.596	0.008	99%
Rochester Fire Headquarters	NY	RPSPEC	A149804G	5.12	0.563	0.558	0.010	98%
Riverside-Rubidoux	CA	SASS	A150101X	5.20	0.806	0.794	0.010	99%
Jefferson Elementary (10th & Vine)	IA	RPSPEC	A134715R	5.21	0.731	0.727	0.014	98%
Phillips	MN	SASS	A139493G	5.21	0.213	0.225	not detected	low capture
IS 52	NY	RPSPEC	A142928Z	5.29	0.656	0.674	0.016	98%
Bakersfield-California Ave	CA	SASS	A1402322	5.25	0.238	0.253	not detected	low capture
Queens College	NY	RPSPEC	A145875F	4.50	0.390	0.341	0.008	low capture

Table 8

Location Name	State	Sampler	Sample Id	pH of Original Extract	Sodium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
G.T. Craig	OH	SASS	A149636I	4.87	0.182	0.193	not detected	low capture
McMillan Reservoir	DC	RAAS	A148663H	5.57	0.652	0.682	0.015	98%
Nampa NNC	ID	SASS	A140524B	5.27	0.162	0.183	not detected	low capture
Wylam	AL	SASS	A1395326	5.39	0.331	0.341	0.010	low capture
Camden	NJ	SASS	A149691P	4.86	0.109	0.129	not detected	low capture
Cornell Elementary	IA	RPSPEC	A1459010	4.80	0.109	0.127	not detected	low capture
Bakersfield-California Ave	CA	SASS	A1439341	5.34	0.164	0.181	not detected	low capture
Haynes Pt.	DC	RAAS	A1459043	5.09	0.293	0.312	not detected	low capture
Washington Park	IN	SASS	A1465705	5.85	0.629	0.631	0.014	98%
Blair Street	MO	RAAS	A1478015	5.73	0.448	0.455	0.011	low capture
Essex	MD	RAAS	A149273B	5.07	0.119	0.121	not detected	low capture
Springfield Pumping Station	IL	RAAS	A1436853	5.15	0.299	0.305	0.009	low capture
Owensboro - KY Wesleyan College	KY	SASS	A1492504	5.61	0.444	0.447	0.008	low capture
Allen Park	MI	SASS	A1395144	5.34	0.323	0.337	not detected	low capture
Fargo NW	ND	SASS	A141940R	5.08	0.279	0.301	not detected	low capture
[BOND1] Bondville	IL	IMPROVE	N02-10322	5.00	-----	0.414	0.013	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10323	5.01	-----	0.532	0.012	98%
[LOST1] Lostwood	ND	IMPROVE	N02-10324	4.64	-----	0.299	0.008	low capture
[WIMO1] Wichita Mountain	OK	IMPROVE	N02-10325	4.46	-----	0.287	0.011	low capture
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10326	4.61	-----	0.235	0.010	low capture
[LOST1] Lostwood	ND	IMPROVE	N02-10327	4.38	-----	0.327	0.012	low capture
[SENE1] Seney	MI	IMPROVE	N02-10328	4.30	-----	0.252	0.012	low capture

Table 8

Location Name	State	Sampler	Sample Id	pH of Original Extract	Sodium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
[LIVO1] Livonia	IN	IMPROVE	N02-10329	5.08	-----	0.303	0.014	low capture
[CADI1] Cadiz	KY	IMPROVE	N02-10330	4.39	-----	0.364	0.014	low capture
[SIPS1] Sipsey	AL	IMPROVE	N02-10331	4.37	-----	0.255	0.012	low capture
[UPBU1] Upper Buffalo	AR	IMPROVE	N02-10332	4.39	-----	0.242	0.010	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10333	4.42	-----	0.999	0.018	98%
[PUSO1] Puget Sound	WA	IMPROVE	N02-10334	4.38	-----	0.405	0.014	low capture
[SAGO1] Saguaro	AZ	IMPROVE	N02-10335	4.59	-----	0.257	0.013	low capture
[LIVO1] Livonia	IN	IMPROVE	N02-10336	4.37	-----	0.240	0.020	low capture
[BADL1] Badlands	SD	IMPROVE	N02-10337	4.47	-----	0.271	0.014	low capture
[MKGO1] M.K. Goddard	PA	IMPROVE	N02-10338	4.66	-----	0.254	0.014	low capture
[PHOE1] Phoenix	AZ	IMPROVE	N02-10339	4.70	-----	0.329	0.013	low capture
[ACAD1] Acadia	ME	IMPROVE	N02-10340	4.39	-----	1.242	0.017	99%
[MACA1] Mammoth Cave	KY	IMPROVE	N02-10341	4.39	-----	0.288	0.015	low capture
[OKEF1] Okefenokee, Wolf Island	GA	IMPROVE	N02-10342	4.23	-----	0.888	0.016	98%
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10343	4.60	-----	0.245	0.013	low capture
[MING1] Mingo	MO	IMPROVE	N02-10344	4.29	-----	0.239	0.016	low capture
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10345	4.59	-----	0.261	0.012	low capture
[MOMO1] Mohawk Mountain	CT	IMPROVE	N02-10346	4.37	-----	0.254	0.015	low capture
[RAFA1] San Rafael	CA	IMPROVE	N02-10347	4.51	-----	0.971	0.018	98%
[LOST1] Lostwood	ND	IMPROVE	N02-10348	4.62	-----	0.271	0.012	low capture
[THRO1] Theodore Roosevelt	ND	IMPROVE	N02-10349	4.39	-----	0.272	0.011	low capture
[GRSM1] Great Smoky Mtns	TN	IMPROVE	N02-10350	4.50	-----	0.246	0.012	low capture

Table 8

Location Name	State	Sampler	Sample Id	pH of Original Extract	Sodium Concentration (ug/mL)			Efficiency of Original Extraction
					Original Extract Analyzed at RTI	Original Extract Re-analyzed at NAREL	Second Extraction (DI Water)	
[HEGL1] Hercules-Glades	MO	IMPROVE	N02-10351	4.37	-----	0.274	0.011	low capture
[AGTI1] Agua Tibia	CA	IMPROVE	N02-10352	4.39	-----	0.516	0.013	98%
[PINN1] Pinnacles, Ventana	CA	IMPROVE	N02-10353	4.64	-----	0.799	0.016	98%
[CABA1] Casco Bay	ME	IMPROVE	N02-10354	4.60	-----	1.551	0.018	99%
[BRMA1] Bridgton	ME	IMPROVE	N02-10355	4.47	-----	0.371	0.012	low capture
[ISLE1] Isle Royale	MI	IMPROVE	N02-10356	4.58	-----	0.251	0.011	low capture
			Mean	4.88	0.35	0.40	0.01	98%
			Maximum	5.85	0.806	1.551	0.020	99%
			Minimum	4.23	0.109	0.121	0.007	98%
			n	72	37	72	56	17